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NEW FINDINGS ON THE TRANSFER OF COMPUTING APPLICATIONS AMONG CITIES*

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ABSTRACT

This paper presents a study of the concepts of transferring computer technology among city governments. A sample of cities from a domestic population and an international population are used as the basis of the research. Contrary to expectation, and for both populations, the survey indicated the level of computer applications transfer among cities was found to be low compared to the amount of total application development. It was determined that an important source of transfer information was from "centers" such as the federal government, vendors, and transfer agencies, rather than city to city. International cities that were studied seem to experience a propensity toward centralized control at the national level. These controls often include the transfer of technical information. Further, the types of transfer may vary widely between the domestic vs the international cities. That is, domestic city transfers tend to be operations-oriented, while transfers from national centers tend to be management oriented. In general the study supported prior conclusions concerning the difficulties of transfer. The problem of mismatch and difficulties in modification make transfers very risky. Even so, there are many persons willing to take the risks in order to try to achieve lower costs and to realize the opportunity to obtain sophisticated applications.

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INTRODUCTION

There has been substantial interest in both the United States and abroad in the concept of transferring computer technology among city governments (Committee for Economic Development, 1976; Kraemer and Perry, 1979; Pennsylvania Office of Science and Technology, 1972; Urban Institute, 1971; Jolly, 1975). This interest has been extended to international technology transfer, from cities in one country to cities in another country, and several organized efforts have been undertaken to achieve that end. These experiments have thus far gone unevaluated, but earlier discussion of computing technology transfer among U.S. cities has indicated a number of serious problems with the concept (Kraemer, 1977; Kraemer and King, 1977b).

This paper develops new insights into the transfer of computing technology by examining the experiences of an international sample of cities. Data are taken from the 1976 URBIS Project Phase II research in forty U.S. cities, and a 1976 study of computing in sixteen cities in nine countries undertaken by the Organization for Economic Cooperation and Development (henceforth referred to as the OECD Study).

The URBIS Project, of which the second phase was recently completed, in a multi-year study of computer use and impact in U.S. local governments. Phase I was a study of computing in 713 local governments (cities over 50,000 and counties over 100,00 population); Phase II was a detailed study of computing in 40 cities selected based on Phase I data. Detailed descriptions of URBIS can be found in Kraemer and King (1977a) and in Kraemer, Dutton, and Northrop (1980). The OECD Study was carried out during 1976 by the Panel on Information Technology and Local Government of OECD. The cities participating were: Vienna, Austria; Vaerloese and Aarhus, Denmark; Helsinki, Finland; Gagny, Montpellier and Toulouse, France; Backnag, Duisburg and Nrutigen, W. Germany; Jonkoping, Sweden; Leeds and Torbay, United Kingdom; Calgary, Canada; and Maebashi and Nishinomiya, Japan. A description of this study can be found in Gaits (1978).

The transfer Concept and Prior Research

The concept of technology transfer usually refers to a process of moving a piece of technology developed at a high cost in one place to another place at a lower cost than would be required to develop the technology locally (Kraemer, 1977; Kraemer and King, 1977b). (For other definitions see Bingham, 1976; Feller and Menzel, 1978; Gray, 1973; Lambright, 1977; Urban Institute, 1977; and Yin, et al, 1976.) The appeal for transfer of computing applications is strong. Theoretically, transfer should benefit all participants. Local government managers get modernization at a reduced price within the constraints of their strapped budgets. National government agencies, which assist local transfers or develop applications for transfer, get high leverage from a relatively low investment by demonstrating nation-wide benefits from their R & D programs. The data processing professionals, who are providers of the technology, get status, recognition, and sometimes profit from their broker function. The department

users in local governments get new tools for performing their jobs more efficiently and effectively. Ultimately, the taxpayer gets better service at a lower cost.

One would expect substantial transfer to occur, based on the positive claims about it. Yet, the level of computer applications transfer among U.S. cities has been found to be low in comparison to the amount of total application development. In an earlier survey of the application transfer experience of all U.S. cities over 50,000 in population, we found that only 22 percent of the responding governments had transferred applications from other local governments in a two year period (Kraemer, 1977). And, only 23 percent planned such transfers within the following two years. Similar low levels of transfer have been reported with respect to computerized operations research models in cities (King and Kraemer, 1979). This low level of transfer casts doubt about the claims of ease and benefit in computer application transfer.

In our earlier analyses, we argued that a primary explanation for the low level of application transfer might be that the true benefits from transfer of computer applications simply are more unclear than with other technologies, and that given this uncertainty, few potential transfer participants are willing to risk engaging in transfer without outside stimulus (e.g., a crisis, or external financial support) (Kraemer and King, 1977b). Actual experience with computer application and model transfer suggested to us that transfer is more complex than the "plug-in" process usually portrayed.

Findings of Our Recent Research

The data from the URBIS Phase II Study and the OECD Study considerably strengthen our understanding of transfer within cities. Several notable findings are revealed by this recent research. First, the level of applications transfer from one local government to another is again rather low compared to all software development. Thus, the conclusion from earlier research that exaggerated expectations of local-to-local transfer success are misplaced is reinforced. However, it is also clear that other sources besides fellow local governments can serve as sources for transferrable applications, and these play a very significant role in transfer. The Phase II cities bring in approximately half of their applications from what we call national "centers" such as the federal government, vendors, and transfer agencies (Table 1). Moreover, it appears that transfers from these centers are more common among larger, more sophisticated cities (Table 2). Indeed, transfers seem to occur more often among such advanced sites, in confirmation of earlier research (Kraemer, 1977).

We do not have identically comparable data on the extent of transfer in the OECD cities, but we do have data on their transfer experiences. The OECD cities all are familiar with the transfer concept, and nearly all have seriously considered transferring applications. Several have done so, and have claimed good results. Six of the OECD cities participate in shared computing arrangements, and have experienced applications transfer among partners in the shared arrangements. Five of the ten OECD cities had "considered transfer-in" of either software packages or software from an-

other local authority. But, only one of the OECD sites with this transfer propensity reported actually transferring-in software. The others considered transfer but opted for in-house development.

The inclination to transfer among the OECD cities seems lower than among URBIS cities. This is probably due to two factors. First, the OECD cities overall lag somewhat behind the URBIS Phase II cities in development and sophistication of computing, and since transfer occurs more frequently among advanced sites, incidence of transfer would be expected to be lower. Second, most of the countries involved in the OECD study are smaller than those in the U.S. study, which makes the pool of useful potential transferrable applications smaller.

A major difference between URBIS and OECD cities in transfer capability is the presence in many of the countries of the OECD study of mechanisms that strongly support transfer activity and sharing of techniques among local governments. These mechanisms evolve out of the more basic arrangements of intergovernmental interaction. Although local governments in all the OECD study countries have considerable autonomy in areas of local policy, they usually are much more centralized and coordinated on a national basis than are U.S. cities (Canada is the major exception). This propensity toward centralized, national direction has important effects. Local governments are often required to implement standardized national policies and programs, with standardized managerial and accounting support requirements, assisted by standardized automated systems. Also, a national perspective and direction usually facilitates communication among local governments, and this communication can facilitate transfer of computing applications. Such centrally inspired communication is rare in the U.S.

Kind of Program	Percent	Number
Programs developed by another local government	44%	(27)
Packaged programs developed outside local government	<u>56</u>	<u>(34)</u>
Total programs transferred	100	(61)

Table 1. PACKAGED VS LOCAL PROGRAMS TRANSFERRED IN THE URBIS PHASE II CITIES

Finally, a national perspective and direction for local governments makes possible truly national policy that mobilizes behind the development of local government information technology. There never has been such a policy in the U.S.; indeed, federal involvement in the area has been a piecemeal affair (Kraemer and King, 1978). These

Indicators of EDP Development Status	Phase II URBIS Cities (1976 Survey)		Phase I U.S. Cities (1975 Survey ^a)	
	Transfer Cities (N=25)	All Cities (N=40)	Transfer Cities (N=51)	All Cities (N=403)
Average EDP expenditures	\$1,552,000	\$1,474,000	\$891,031	\$554,444
Average EDP expenditures as a percent of total operating budget	1.3%	1.3%	1.4%	1.0%
Average total core capacity in bytes	797K	577K	596K	346K
Average total operational applications	73	63	44	31
Average total functional areas automated	17	16	14	11
Average number of terminals available	45	31	20	10

All cities over 50,000 population were included in
a the 1975 survey.

Table 2. COMPARATIVE STATE OF COMPUTING DEVELOPMENT IN URBIS PHASE I AND PHASE II CITIES
THAT HAVE TRANSFERRED-IN APPLICATIONS

Kind of Application	Transfers-In Percent Cities	Transfers-Out Percent Cities
Management-oriented	28% (17)	3% (1)
Management-and operations-oriented	13% (8)	12% (4)
Operations-oriented	<u>59% (36)</u>	<u>85% (29)</u>
	100% (61)	100% (34)

Table 3. KIND OF APPLICATIONS TRANSFERRED IN THE URBIS PHASE II CITIES

differences in context between the U.S. and the majority of the OECD cities raises the question of what transfer really means.

In URBIS Phase II cities, transferred applications tend to vary in their purpose according to their source. Applications transferred in from other local governments tend to be operations-oriented, while those transferred in from national centers tend to be management oriented (Table 3). All transferred applications reflect the basic foci of application development in local governments generally--the areas of finance and law enforcement. In the OECD cities, applications that spread widely among cities within given countries are usually support systems designed to facilitate implementation of locally administered national programs. Often these are social welfare applications. Law enforcement is seldom a local responsibility in the same sense as it is in the U.S., and the lack of law enforcement application reflects this. There is widespread interest in routine, financial applications in the OECD cities as in the URBIS cities.

The major incentives for transfer in URBIS are cost and time savings and availability of special and/or sophisticated applications (Table 4). The OECD cities appear to have the same objectives in mind for transfer, based on comments made in interviews with city executives. Problems with transfers in URBIS cities are mainly need for extensive modification after acquisition and problems of poor documentation (Table 5). Need for modification is greater with packaged programs, while documentation problems are more serious with applications transferred from other local governments. In OECD the problems with transfer are similar; primarily lack of match between local needs and the capabilities of potentially transferrable applications.

Transfers themselves go only one direction (from the transferor to the transferee), but individual cities can be importers (transfer-in only), exporters (transfer-out only), or both. We analyzed URBIS Phase II data to determine the extent to which these three modes of transfer take place in local governments. OECD data were not specific on this point, and unfortunately could not be included. Basically two things are shown by the URBIS data. First, most transfer takes place among the larger, more sophisticated cities. These more developed sites not only transfer more among them-

Table 4. IMPORTANCE OF REASONS LEADING TO TRANSFER-IN OF AN APPLICATION RATHER THAN DEVELOPING IT IN-HOUSE IN THE URBIS PHASE II CITIES^a

Reasons	Not Important	Somewhat Important	Very Important
Cost Savings	0%	48%	52%
Application would be operational sooner	0	32	68
Sophisticated application	40	40	20
Facilitates mandated reporting requirements	65	26	9
User request	24	44	32
Other	82	0	18

(e.g., departmental marketing/competition; low potential use without transfer cost and high development cost; output was standardized nationally; the system was free; compatibility)

^aN=25

Table 5. PROBLEMS ENCOUNTERED IN THE TRANSFER-IN OF APPLICATIONS IN THE URBIS PHASE II CITIES

Problems	No Problem	Minor Problem	Major Problem	
Poor documentation for management	24%	52%	24%	(N=25)
Poor documentation for systems programmers and operators	8	52	40	(N=25)
Needed extensive modification for user operations	24	36	40	(N=25)
Needed extensive modification to run on our computer system	28	44	28	(N=25)
Other	86	4	9	(N=22)

(e.g., training users and EDP staff; maintainability; transfer agreements; poor user documentation; user acceptance of untailored reports.)

selves, but they are far more likely to transfer-in applications from transfer centers than are less developed sites. Second, when the smaller, less developed sites do transfer-in applications, they frequently get the applications from larger, more developed sites. Thus, in some cases transfer does assist less developed sites in acquiring more advanced computing applications, but this is not common.

Conclusions

These findings from our recent research provide several conclusions. First, this research shows that our earlier conclusions about the difficulties of transfer are largely correct, but must be expanded to account for the subtleties of real situations. The earlier conclusions held that the "calculus of winning or losing" in transfer is unclear; this seems verified by the URBIS Phase II data and by the OECD data. The problems of mismatch and difficulties in modification make transfers very risky. Nevertheless, among the URBIS cities there are many willing to take the risks in order to try to achieve the benefits of lower costs and the opportunity to obtain sophisticated applications. The fact that different sources for applications tend to yield different kinds of applications (and applications with different kinds of problems) indicates that there might be a subtle calculus in operation when local governments evaluate a specific transfer possibility.

Unfortunately, our relatively limited data on incidence of transfer are insufficient to carry this analysis further, where it should be taken. Detailed tracing of transferred applications from source to implementation and routinization within the transferee organization is needed. Also needed is study of how the decision to transfer-in an application is made by a local government. The decision to transfer-in is most critical in the local government context, since it is the transferee that essentially determines transfer success. The "centers" have either a financial stake or a mandate to promote application packages, while other governments that transfer-out do not generally actively market their applications. The government that transfers-in takes the initiative to listen to and choose among the active promoters from the centers, or to search among other local governments for suitable transferrable applications. The decision process by which local governments arrive at the resolution to transfer-in applications would provide a fruitful arena of study, both in the context of computer applications transfer and technology transfer generally.

The second conclusion is that conventional conceptions of transfer lack definitional precision, making them difficult to apply in some research situations. The definition of transfer is extremely important when trying to evaluate the effectiveness of transfer activity, but this definition is not yet sufficiently developed. Generally, the term denotes the movement of technology across major organizational boundaries--for example, from one city to another. Yet, organizational boundaries that make sense in one context might not in another. Organizational boundaries of the transferee/transferrer in URBIS cities are obscured through local government participation in consortia such as the "Urban Consortium" administered by Public Technology, Inc. and the

various "innovation groups" such as the Southwest Innovation Group and the New England Innovation Group. Similarly, in the OECD countries there are consortia providing computing service or application development that serve all or most local governments. Because the local governments formally belong to these organizations, they are in some sense engaging in intra-organizational transfer when they exchange technologies with one another.

This problem of boundary specification makes it difficult to compare the state of computer applications transfer internationally. For example, in the U.S. there are very few consortia for sharing computing knowledge or development. In Denmark a single large company called Kommunedata which is owned by the national association of local governments provides computing services to all 276 cities in the country, making every local government a member of the consortium. If transfer is narrowly defined to take place only between legally separate entities, Denmark would show no transfer; but if the definition is looser, and includes this consortium arrangement, Denmark would show an incredibly high level of transfer. This paper does not redefine the concept of transfer. We simply point out the great difficulty of applying an incompletely defined concept to an actual comparative and empirical evaluation. More attention should be focused on the issue of defining the transfer concept so it is flexible enough to apply across varying situations, yet specific enough to context to provide clear benchmarks for comparison of transfer accomplishments.

The third major conclusion, and perhaps the most significant, is that technology transfer is not a static, predictable activity. It is a highly dynamic phenomenon that exhibits definite but complex patterns. This has been discussed both in the theoretical literature, as well as in other empirical studies of transfer. The major contribution of this study is the identification of a particular pattern of interactions among actors in a particular arena of transfers. The transfers of computing applications cluster around a core of "lead" cities. These cities serve three purposes. First, they are generally the more highly developed users of the technology, although not necessarily the most advanced users, which typically develop everything in-house. Thus, they generally provide an impetus to broader development and advancement of the technology's use. Second, they are experimenters that take on the packaged applications developed by national centers and give them their in vivo trials. Thus, they are a proving ground for sophisticated packaged systems that might or might not provide a boon to local governments generally. Finally, they serve as sources for the comparatively few smaller and less well developed governments that want to transfer-in advanced applications. This core of lead cities is, in network terms, a "node" in the communication linkages among governments that provide the base for transfer activity.

Further study of computer application transfer among all cities would probably reveal that there are actually multiple nodes, differentiated by areas of applications specialty (e.g., police, finance, libraries, etc). Identification of these sites could prove useful in further nationally-funded transfer promotion efforts, since choice of such "natural" leaders would probably facilitate transfer considerably.

Two other aspects of transfer dynamics hinted at by this study are worth noting. One is that the political and organizational context of transfer is critical for determining what the dynamics of transfer will be like. It is fascinating to notice, for example, that in some European countries with systems that very much encourage sharing of computing facilities and procedures, exchanges of software are just about as infrequent as they are in many U.S. cities. Apparently, exchange of software is not so enthusiastically looked upon when it is compelled as when it is completely voluntary.

The other aspect of transfer dynamics hinted at by this study is that, within the U.S., transfer might be on the increase. Several indications of this are apparent. There is an increase in the federal government's commitment to seeing this happen, through what appears to be permanent institutionalization of various technology transfer assistance efforts. Some argue that the most fundamental purpose of these efforts is not to affect transfer among the local governments, but to create a climate where local governments themselves are willing and able to engage in transfer on their own. If this is true, it takes time. And if it can be done, it might begin to demonstrate success within the near future. Another key indication is that a considerable armada of private firms have begun to actively market specialized systems for local governments, and with success. The class of "transfers" from vendors to local governments is almost certainly on the rise. It is helped along by the fact that some of these systems are truly good and useful, and by the mood of the times that tends to favor outside purchase or private contracting to hiring of in-house staff for development.

If these indicators prove true, our earlier findings on the lack of transfer will take on historical rather than permanent significance. Nevertheless, we believe that the barriers to transfer articulated in our earlier research are still considerable. If, and when, transfer becomes a major method of software acquisition of local governments, it will be because the barriers to transfer have been successfully overcome.

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